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ABSTRACT

The Precursors Study, initiated in 1946, has focused on searching for links between psychological patterns and future disease and death. Gathering a broad spectrum of psychobiological characteristics from a large group of medical students, this study has continued year after year. This study examined the role of psychological factors on mortality, especially on early deaths since deaths that occur later in life may be more influenced by organic processes due to aging. A total of 1,337 Johns Hopkins medical students (1,216 male, 121 female), who were enrolled in classes graduating between the years 1948 through 1964, were administered a wide variety of physical, physiologic, and psychological tests, among the latter the Habit Survey and Family Attitudes questionnaires. Since graduation, the subjects have been followed annually through the use of mailed questionnaires and telephone interviews to determine overall health. Results suggest a greater risk of mortality is associated with lack of closeness to parents and with a Tension-In type of temperament. This risk was especially evident for early mortality, defined as death before age 50. In the future when numbers of deaths from a single cause accumulate, it may become possible to pinpoint the contributions of psychological factors to mortality with greater specificity. (BHK)

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PSYCHOLOGICAL PREDICTORS OF MORTALITY:

EVIDENCE FROM A 41-YEAR PROSPECTIVE STUDY

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It is now widely accepted that individual health and states of illness are processes which are affected by a multitude of factors. Less acknowledged is the possibility that death may be a result of processes, similarly affected by a multitude of factors. World Health Organization has defined health as "a state of complete physical, mental, and social well-being" (WHO, 1964), emerging out of the dynamic interaction of factors from physical, mental, and social domains. Is death a process where factors from these same domains converge?

This report from the Precursors Study examines the role of two psychological factors from the mental domain on mortality. It thus continues the tradition of the Study, which since its initiation in 1946 (Thomas, 1988) has focused on a search for links between psychological patterns and future disease and death. Gathering a broad spectrum of psychobiological characteristics from a large group of medical students, the study has continued following its subjects year after year. It is now in a unique position to examine whether youthful psychological characteristics may predict premature death.

This report addresses two questions. The first question is: Do psychological factors measured in youth predict mortality? The second question is: Are psychological factors more strongly related to early death (defined as death occurring before 50 years of age)? Deaths occurring later in life may be more influenced by organic processes due to aging.

Method

Subjects and data base.

The Precursors Study is a long-term prospective investigation of the precursors of subsequent disease and death. A total of 1,337 Johns Hopkins medical students (1,216 male, 121 female), who were enrolled in classes graduating between the years 1948 through 1964, were administered a wide variety of physical, physiologic, and psychological tests, among the latter the Habit Survey and Family Attitudes questionnaires.

Since graduation the subjects have been followed annually through the use of mailed questionnaires and telephone interviews to determine their overall health. About two thirds of all living subjects respond to follow-up inquiries each year, while 87% to 94% of a given class provide information during any five-year period. The duration of follow-up currently spans 25 to 41 years. Most subjects are now teaching and practicing physicians in their 50s and 60s.

As of December 1989, 113 subjects had died. Their deaths were verified by spouses or relatives, or by the National Death Registry; in all instances death certificates confirmed the event. Because of the relatively small number of deaths from any single cause, the reported findings are based on mortality from all causes.

Psychological measures

The two psychological measures which were used in the present analysis were

Closeness to Parents scale and Habit Profile of Temperament. They were administered to the medical students at the mean age of 23 years.

Closeness to Parents Scale. The Closeness to Parents scale is one of three scales derived from the Family Attitudes Questionnaire. This questionnaire is a self-administered checklist of 65 adjectives concerning family attitudes as perceived retrospectively by young adults between father - child, mother - child, father - mother. The Closeness to Parents scale, containing 15 positive and 10 negative items for a total of 25 items, has a possible range of scores -10 to +15. The mean score for the 928 male students who completed the questionnaire was 8.59 (SD = 4.47); for the 80 women the mean was 7.47, SD = 5.15. The scale has shown to distinguish subjects who later committed suicide or developed cancer from their healthy controls (Thomas & Greenstreet, 1973; Thomas & Duszynski, 1974; Thomas et al., 1979).

The Habit Profile of Temperament. Because temperament as a concept in mortality studies is new and because our measure has certain important methodological features, the measure will be described in a somewhat greater detail.

We defined temperament as referring to consistent, basic dispositions, inherent in the person, which would modulate the expression of activity, reactivity, emotionality, and sociability (Goldsmith et al., 1987). These four categories of dispositions, which reflect styles of behavior, were the basis of selecting items for the temperament measure.

A habit survey questionnaire, provided us with ten following items:

Activity:	Eat fast
	Increased activity under stress
	Interested in active athletics
Reactivity:	Difficulty in sleeping under stress
	Loss of appetite under stress
	Urinary frequency under stress
Emotionality:	Anxious feelings under stress
	Anger under stress
Sociability:	An urge to confide under stress
	Prefers social recreation.

These items were submitted to latent class analysis. This mathematical model is similar to factor analysis, but is applied to categorical data. The analysis yielded a three-class model of temperament. One class showed a consistently low probability of responding "yes" to each item, in particular to the items "eats fast", "increased activity", "uneasy, anxious feelings", and "urge to confide". It was therefore called STABLE, and the type was characterized as "slow, solid, self-contained".

The remaining two classes showed relatively similar probabilities in many items. The first of these, however, had a very high probability (more than 99%) of losing appetite under stress as well as difficulty falling asleep. In contrast, the second class tended to increase activity and react more with anger when under stress. We considered these differences clinically important, because they suggested distinct and

separate pathways in reactivity. Thus we called these two classes or profiles as TENSION-IN and TENSION-OUT. The Tension-In type was characterized as "anxious, tense; tension expressed via somatic or neurophysiological reactivity". The Tension-Out type, while anxious and tense as well, was "more restless, more volatile, hence behaviorally more expressive".

After the classes had been established, 1,137 medical students (1,046 male and 91 female medical students) were designated as one of the three temperament types: Tension-In, 320 (28%); Tension-Out, 194 (17%); and Stable, 623 (55%).

Comparisons between the obtained three profiles of temperament and other personality types established by other investigators raised the a priori hypothesis that the Tension-In type may be more vulnerable than the other two temperament types when faced with stresses of life, including serious illness or premature death.

Statistical analysis

We used the univariate Kaplan Meier survival analysis (Kaplan & Meier, 1958) and the multivariate Cox proportional hazards model (Cox, 1972) to examine the association between the psychological measures and mortality. In the Cox proportional hazards model the measures were adjusted for the following variables obtained from medical school measurements. The variables were selected because an association between these variables and mortality has been frequently described. The variables were:

Serum cholesterol level (mean 225.9, SD 41.81);

Quetelet Index (weight in kilograms divided by height in meters squared) (mean 22.91, SD 2.58);

Age at graduation (mean age in years 26.36, SD 2.41)

Smoking (number of smokers 498, 43.6%)

Results

Total mortality.

We first examined the association of Closeness to Parents scale to mortality in univariate survival analysis. For the purposes of the analysis the Closeness to Parents scale , which is a continuous variable, was divided into quartiles to create four groups, the group with the lowest scores indicating a lack of closeness to parents. In the Kaplan-Meier survival curves (Figure 1) the vertical axis is the cumulative incidence of death plotted against age in years. The curves show that the subjects with the lowest scores in the test had a greater risk of death than those with higher scores (the logrank test for overall significance between the four curves, $p = 0.02$). The subjects with the lowest scores showed a 14.1% cumulative proportion of mortality by the age of 55. Interestingly, the remaining three groups differed relatively little from each other in the cumulative proportion of mortality: by the age of 55, the proportions of death in groups 2, 3, and 4 (with the highest scores) were 5.4%, 5.1%, and 5.0%, respectively.

A parallel analysis of the temperament measure, shown in Figure 2, indicated that the cumulative proportion of subjects who died differed significantly between the three temperament groups (the logrank test for overall significance between the three curves, $p = 0.02$). Specifically, the subjects in the Tension-In temperament group were at a greater risk of mortality than those belonging to the Stable or the Tension-Out groups. By the time the surviving subjects reached the age of 55 years, 10.03% of the Tension-In group had died compared to 3.11% of the Tension-Out and 4.53% of the Stable groups.

The two psychological measures were then adjusted for the baseline variables -- age, smoking, serum cholesterol level, and Quetelet Index. In Cox proportional hazards analysis, both measures persisted as predictors of mortality (Closeness to Parents scale, $p = 0.01$; Habit Profile of Temperament, $p = 0.025$). Table 1 shows the relative risk of dying associated with quartile of the Closeness to Parents scale. The group with scores indicating least closeness had a 2.28 greater relative risk of dying when compared with the group who were closest to their parents.

Table 2 shows parallel results from the Habit Profile of Temperament. Accordingly, students belonging to the Tension-In temperament type showed a higher risk of mortality than those belonging to the other two types (relative risk 1.56, 95% confidence interval 1.00, 2.44).

Early mortality

We next examined the association between the psychological measures and mortality when death occurred before the age of 50 years. This age was arbitrarily chosen. Forty nine subjects had died before this age.

The univariate survival analysis (Figure 3) showed that subjects with a lack of closeness to parents defined using the Closeness to Parents scale were at the highest risk of early death (5.75% versus 1.86% among subjects with the highest scores), although the overall difference between the curves failed to reach significance (logrank test $p = 0.08$). In contrast, the Habit Profile of Temperament maintained its predictive potential (Figure 4, logrank test for overall difference between the curves, $p = 0.003$). Specifically, the subjects in the Tension-In group had the highest proportion of early deaths (6.88%), while the subjects in the Tension-Out group had the lowest (2.06%); the subjects in the Stable group were placed close to the latter (2.89%).

When the two measures were adjusted for the baseline covariates, both measures significantly predicted early death (Habit Profile of Temperament, $p=0.005$; Closeness to Parents, $p = 0.025$). Table 3 shows the relative risk of early death associated with quartile of the Closeness to Parents scale. Subjects indicating a lack of closeness to parents were at the highest risk of dying before the age of 50 years. The relative risk in this group was 5.05 (95% confidence interval 1.13, 22.56) when compared with the group indicating most closeness.

Table 4 shows the relative risk of early death associated with the temperament

measure. Here, subjects with the Tension-In temperament type were at the highest risk of dying before age 50. Keeping the Stable group as a reference group. the relative risk for Tension-In group was 3.04 (1.50, 6.18).

Discussion

In summary, we found that a greater risk of mortality was associated with lack of closeness to parents and with a Tension-In type of temperament. This risk was especially evident for early mortality, defined as death occurring before the age of 50 years. We thus conclude that psychological factors are important risk factors for mortality.

We are aware that our definition of premature death is arbitrary (less than 50 years). It is possible that the optimal risk of each psychological factor may be different from the selected age limit and may even differ between the two measures. The present method also prevented us from examining differences between premature and later mortality. We are planning to apply a more powerful statistical approach, developed by our colleagues, which will allow us to use all data in order to test for early versus late differences and to arrive at an objective way of determining "early" versus "late" events.

Because of small numbers of deaths for single causes we analyzed total mortality. It is possible, however, that specific psychological characteristics may need to be identified for specific caused of death. Such has been shown to be the case with

specific disease states. Accumulated evidence indicates, for example, a strong link between coronary heart disease and a type of behavior where ambitiousness, aggressiveness, hostility, and competitive drive dominate (Barefoot et al., 1983, 1987; Shekelle et al., 1983). In contrast, a totally different type of personality , characterized by interpersonal loneliness and suppression of emotions, is frequently found to predict cancer (Grossarth-Maticek et al., 1985; Graves et al., 1986). In our study, when numbers of deaths from single causes accumulate, it may become possible to pinpoint the contribution of psychological factors to mortality with greater specificity. Such an exploration may also help define the various pathways through which the mind and body influence one another to produce health or premature death.

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Figure 1.

Cumulative Total Mortality by Quartiles of Closeness to Parents Scale

Kaplan Meier Analysis

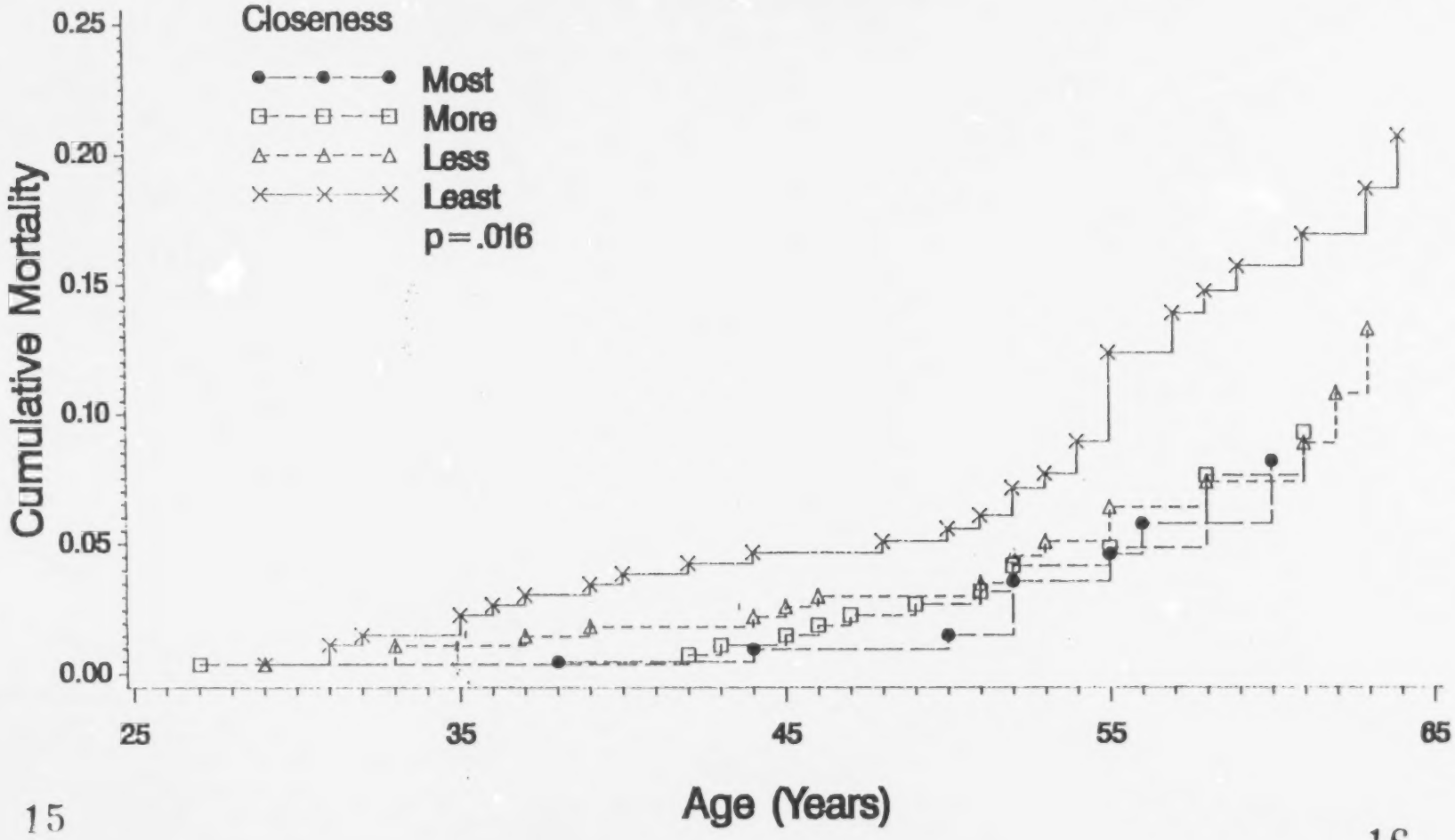

Figure 2.

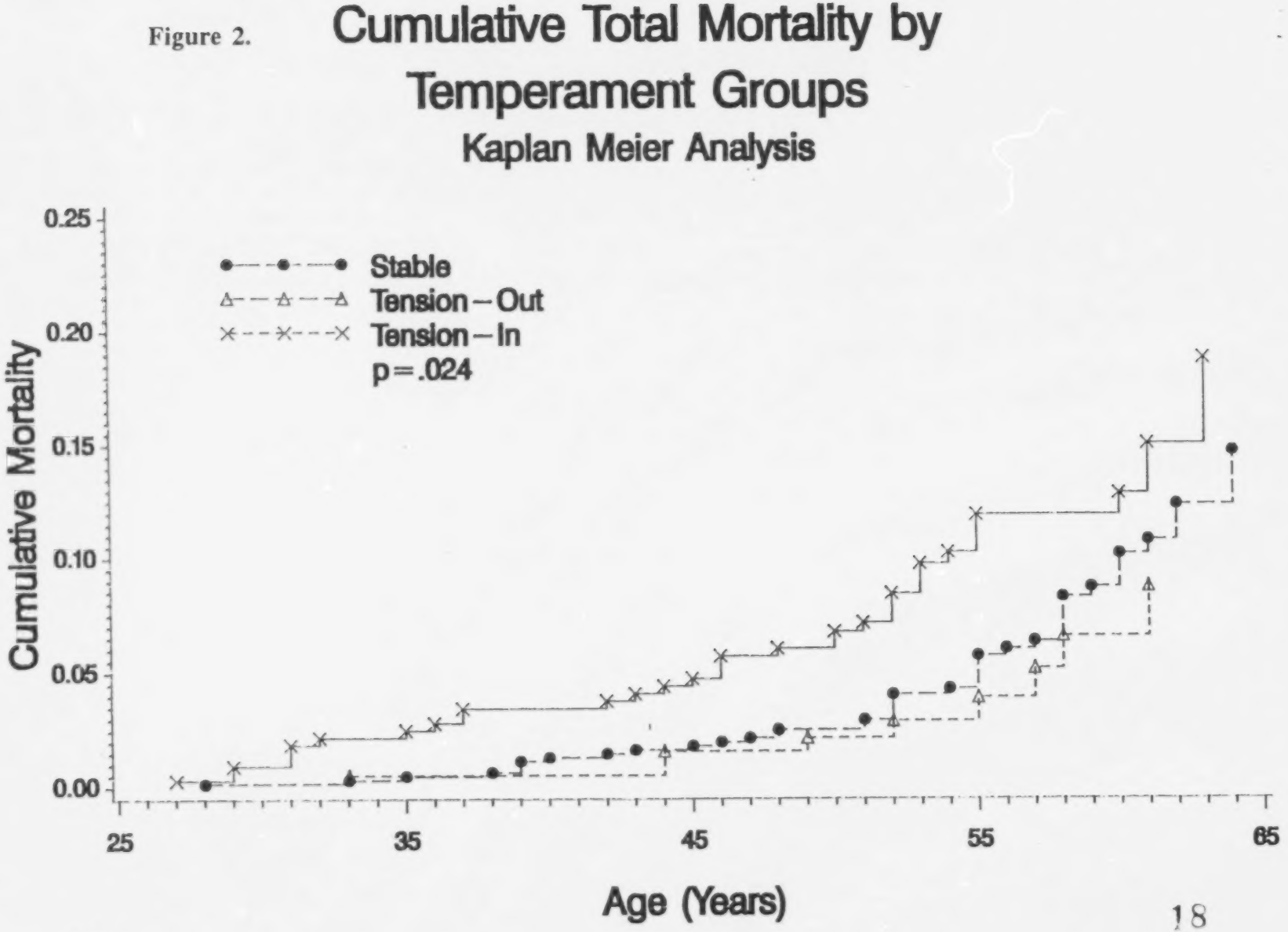
Cumulative Total Mortality by
Temperament Groups
Kaplan Meier Analysis
Stable
Tension – Out
Tension – In
p = .024
Cumulative Mortality
0.25
0.20
0.15
0.10
0.05
0.00
25
35
45
55
65
Age (Years)

TABLE 1.

RELATIVE RISK OF MORTALITY OVER 25 TO 41 YEARS OF FOLLOW-UP IN 932 SUBJECTS BY CLOSENESS TO PARENTS SCALE

Quartile	Relative Risk*	95% Confidence Interval
1 (Least close)	2.28	(1.03, 5.05)
2	1.62	(0.71, 3.68)
3	1.02	(0.42, 2.44)
4 (Most close)	1.00	

* Cox proportional hazards model adjusted for age at graduation, serum cholesterol level, Quetelet Index, and smoking in medical school.

TABLE 2.

RELATIVE RISK OF MORTALITY OVER 25 TO 41 YEARS OF FOLLOW-UP IN 1,046 SUBJECTS BY TEMPERAMENT TYPE

Temperament Type	Relative Risk*	95% Confidence Interval
Tension-In	1.56	(1.00, 2.44)
Tension-Out	0.60	(0.29, 1.23)
Stable	1.00	

* Cox proportional hazards model adjusted for age at graduation, serum cholesterol level, Quetelet Index, and smoking in medical school.

Figure 3.

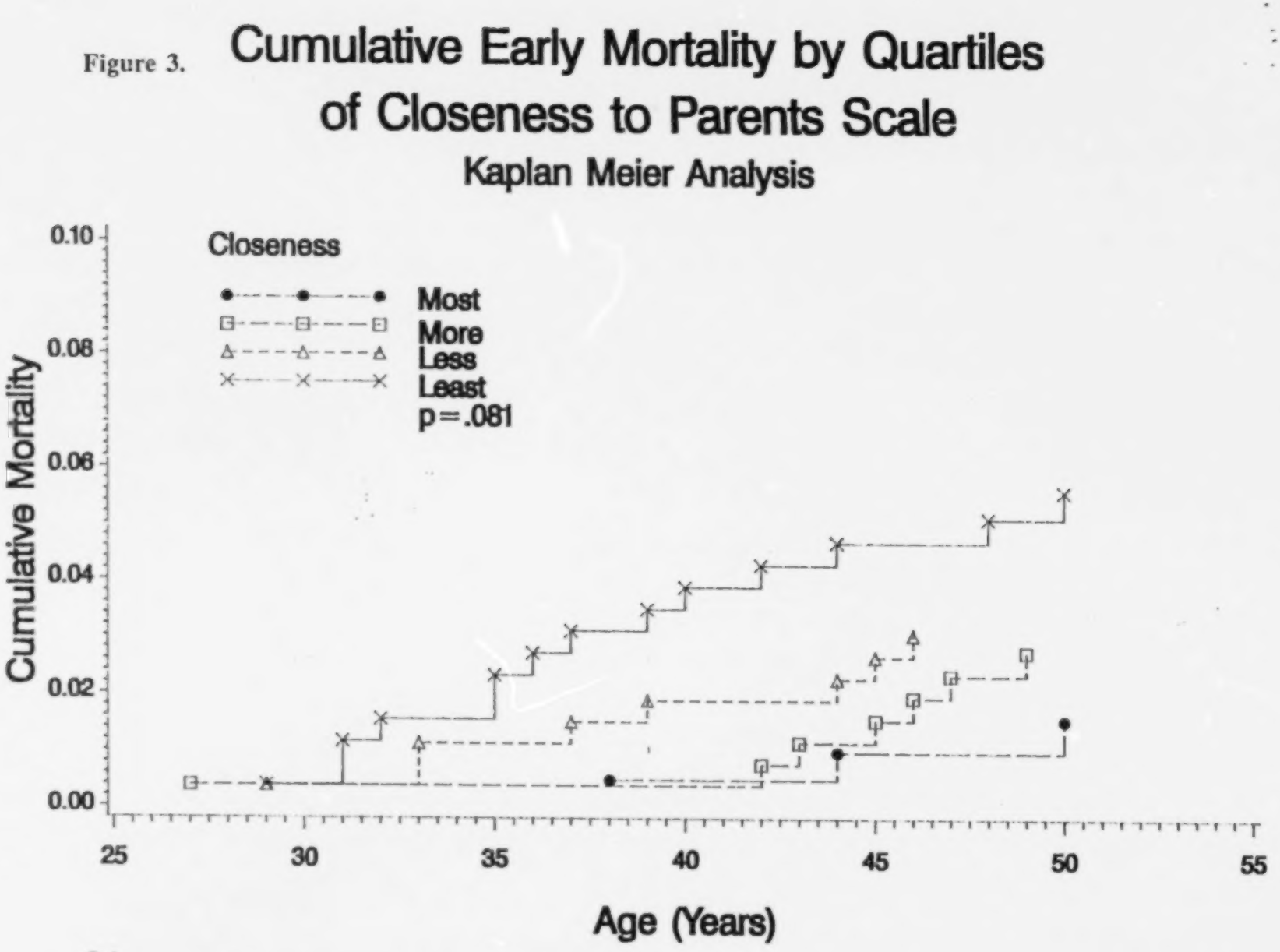
Cumulative Early Mortality by Quartiles of Closeness to Parents Scale
Kaplan Meier Analysis
Closeness
Most
More
Less
Least
p=.081
Cumulative Mortality
0.10
0.08
0.06
0.04
0.02
0.00
25
30
35
40
45
50
55
Age (Years)

Figure 4.

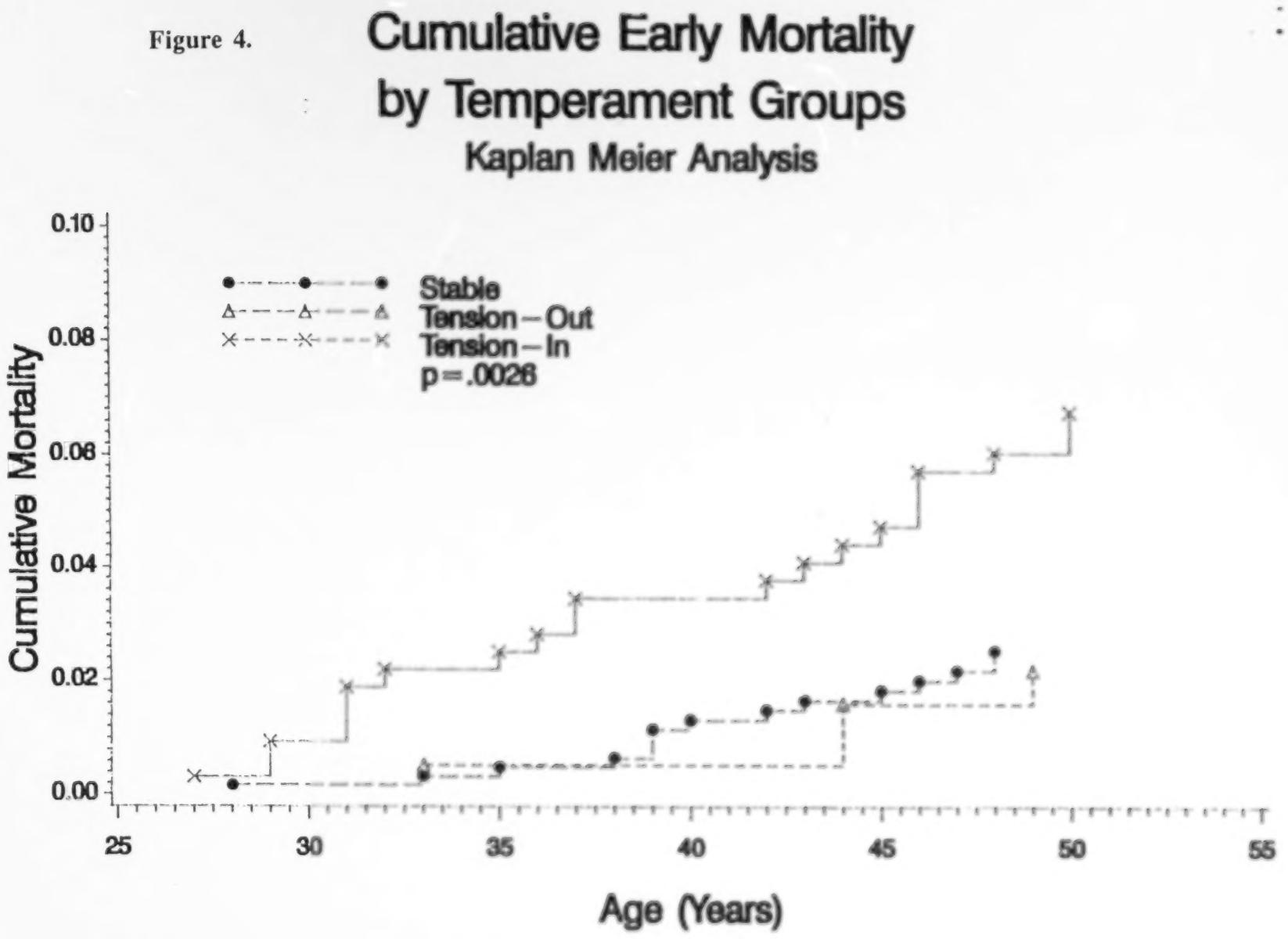
Cumulative Early Mortality
by Temperament Groups
Kaplan Meier Analysis
Stable
Tension – Out
Tension – In
p = .0026
Cumulative Mortality
0.10
0.08
0.06
0.04
0.02
0.00
25
30
35
40
45
50
55
Age (Years)

TABLE 3.

RELATIVE RISK OF EARLY DEATH OVER 25 TO 41 YEARS OF FOLLOW-UP IN 932 SUBJECTS BY CLOSENESS TO PARENTS SCALE

Quartile	Relative Risk*	95% Confidence Interval
1 (Least close)	5.04	(1.13, 22.56)
2	3.01	(0.64, 14.18)
3	2.03	(0.41, 10.06)
4 (Most close)	1.00	

* Cox proportional hazards model adjusted for age at graduation, serum cholesterol level, Quetelet Index, and smoking in medical school.

TABLE 4.

RELATIVE RISK OF EARLY DEATH OVER 25 TO 41 YEARS OF FOLLOW-UP IN 1,046 SUBJECTS BY TEMPERAMENT TYPE

Temperament Type	Relative Risk*	95% Confidence Interval
Tension-In	3.04	(1.50, 6.18)
Tension-Out	0.90	(0.29, 2.77)
Stable	1.00	

* Cox proportional hazards model adjusted for age at graduation, serum cholesterol level, Quetelet Index, and smoking in medical school.